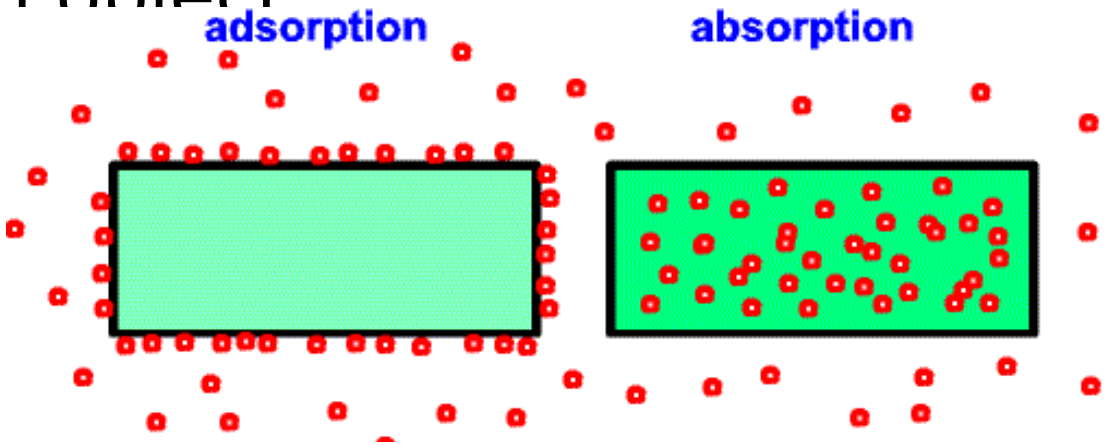
SAS4323 Surfactant

Lecture 5
Adsorption, Electrical Double Layer and Micelle Formation

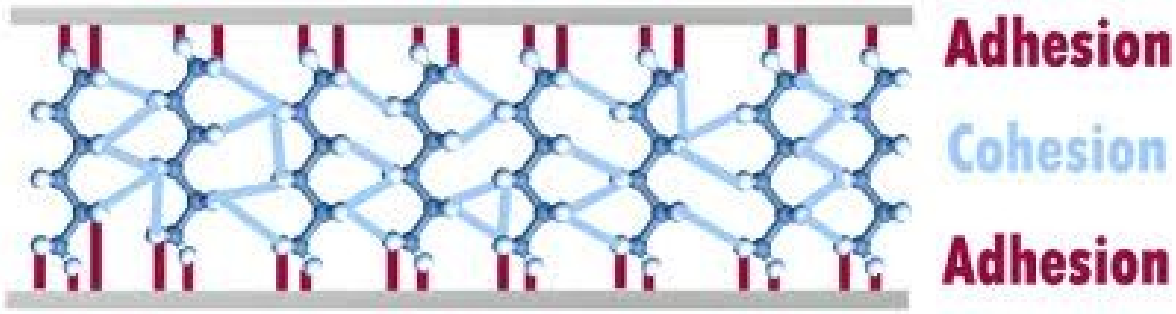
Definitions

- Adsorption
  - Molecules attached to the surface/interface
- Absorption
  - Material entered into the interior of an object



Definitions

- Adhesion(□□)
  - Molecule of one kind attach to molecule of another kind
- Cohesion(□□)
  - Molecules of the same kind cling together



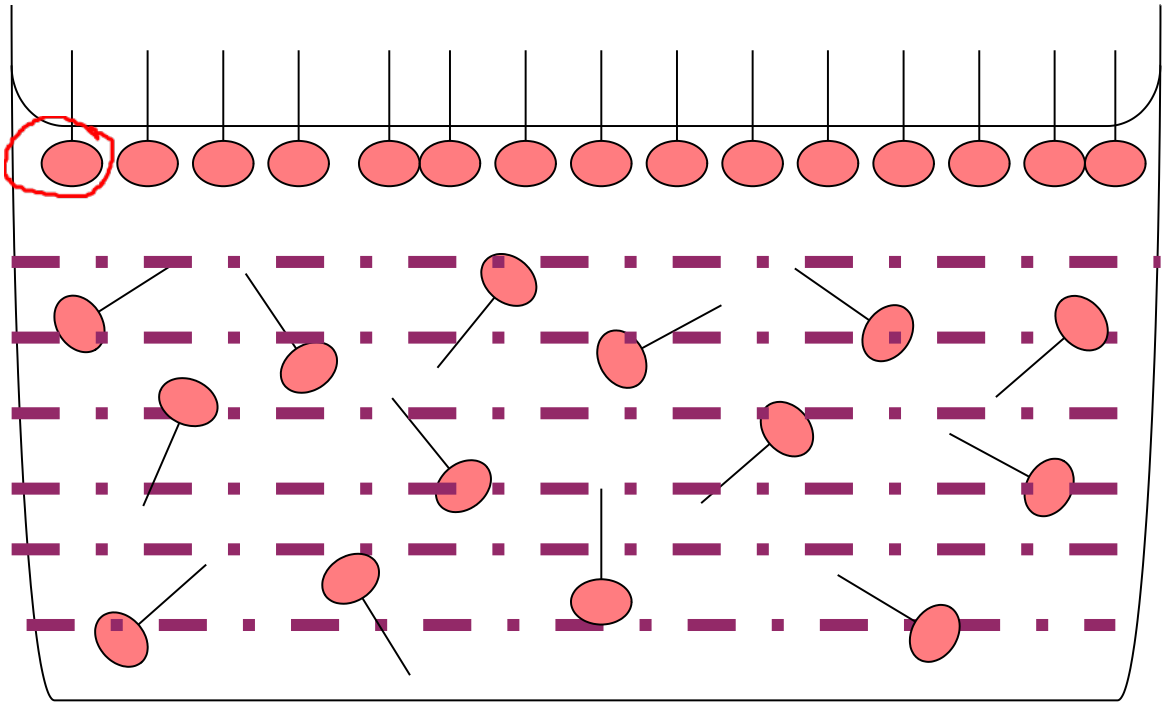
Molecules in Solution

- The distribution of solute molecules inside a solvent will always be the minimization of the total free energies of the system
  - Free molecules in solution
  - Aggregates(□□) in solution
  - Adsorbed in the surface with preferred orientation

Adsorption at Interface

- Surfactants have a tendency to adsorb at interfaces in an oriented fashion
- Adsorption of surface-active agents can affect detergent properties
  - Wetting
  - Foaming
  - Emulsification
  - Detergency

Adsorption at Liquid / Air Interface



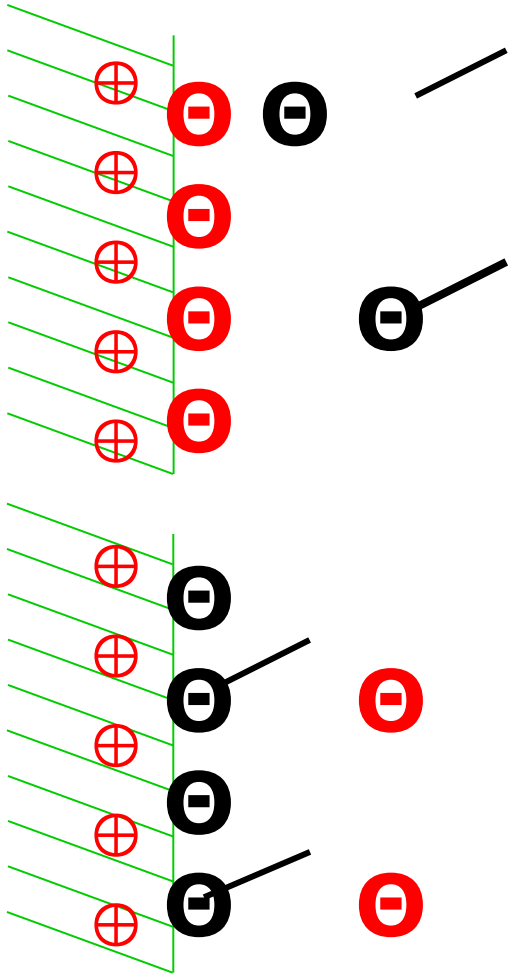
Idealized representation of positive adsorption and selective orientation of detergent molecules at a water surface

Adsorption Mechanism

- Ion Exchange
  - Replacement of counter ions adsorbed onto the substrate from the solution by similarly charged surfactant ions

- Ion Pairing
  - Adsorption of surfactant ions from solution onto oppositely charged sites unoccupied by counter ions

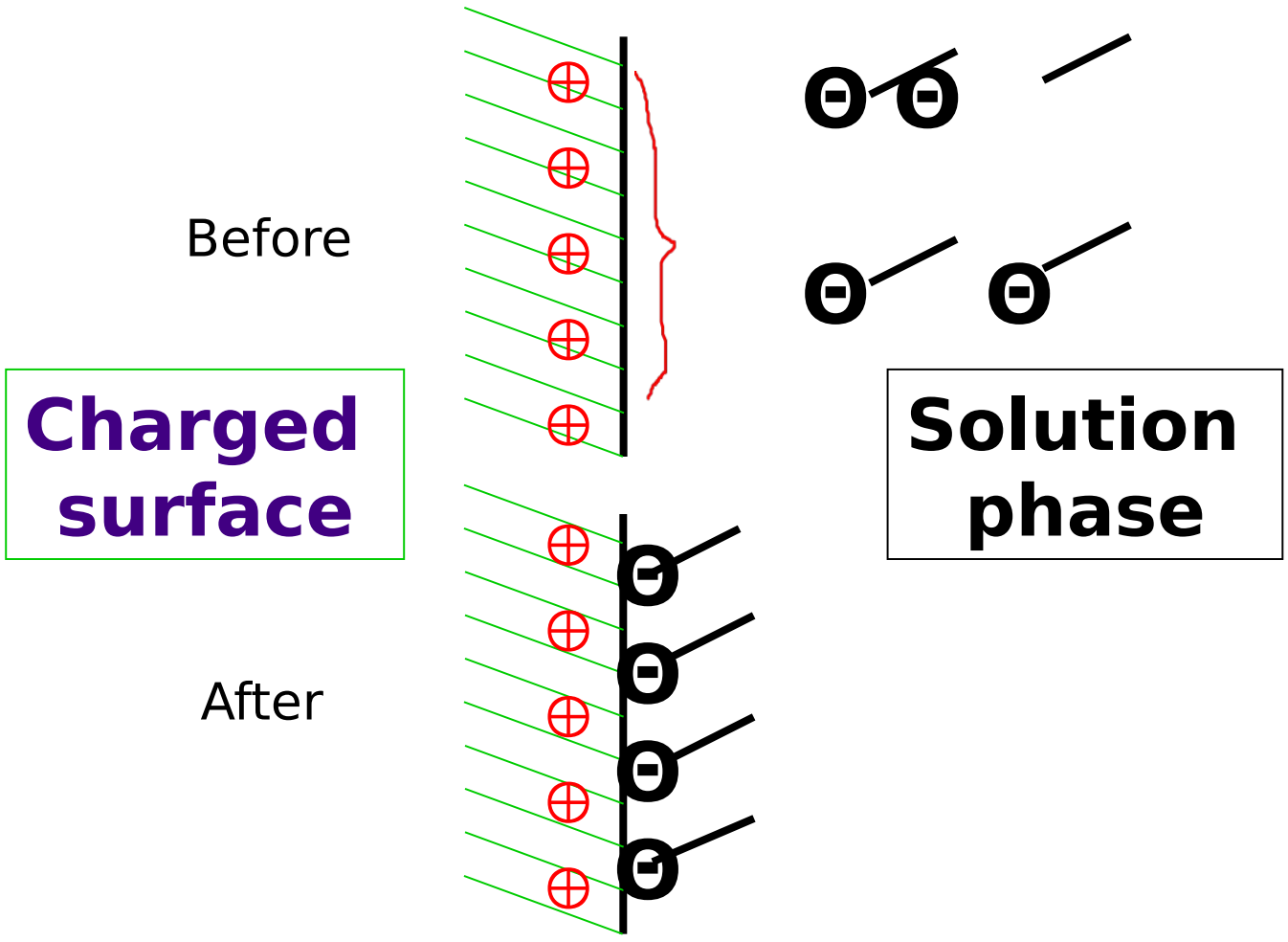
Ion Exchange



Charged surface

Solution phase

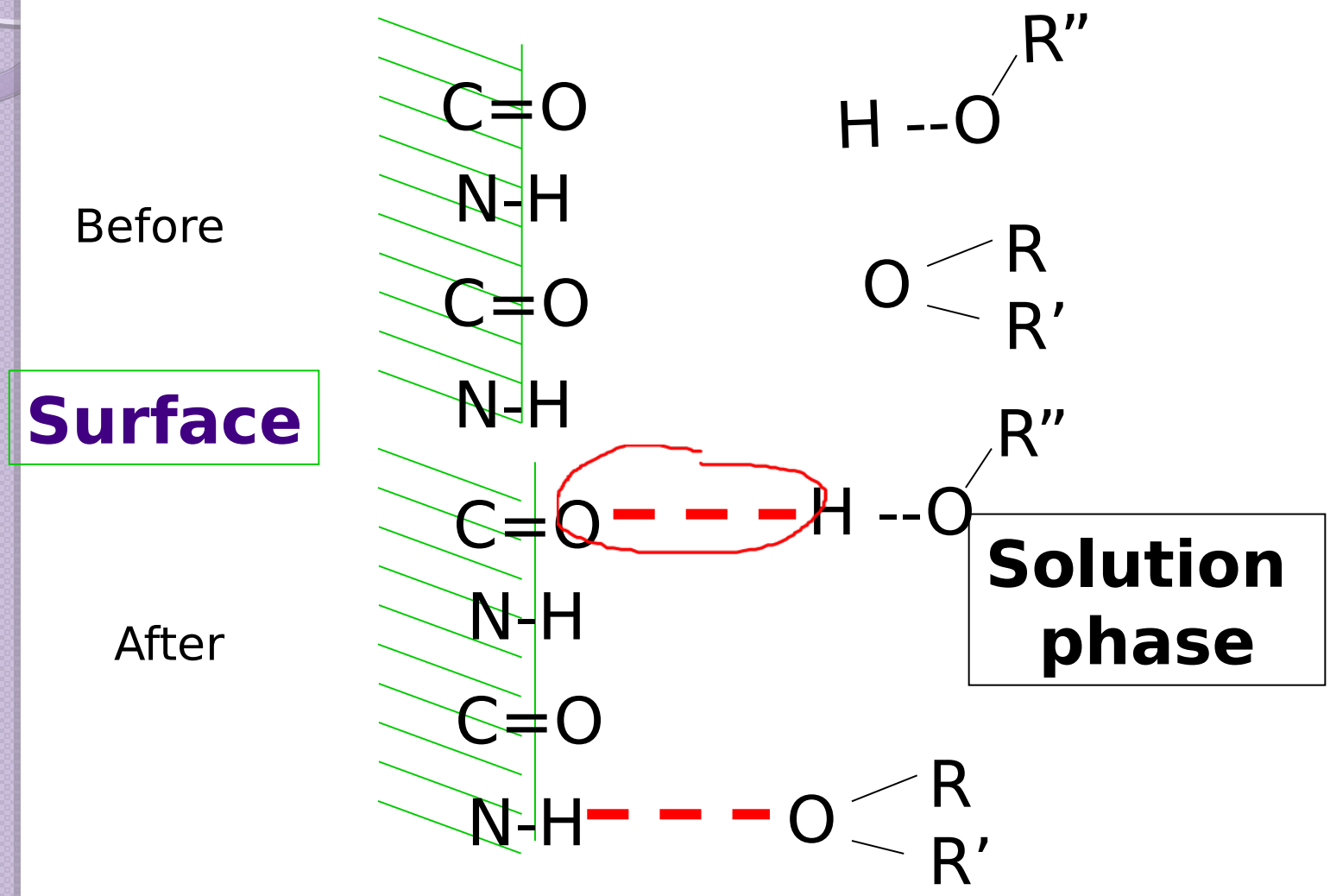
Ion Pairing



Adsorption Mechanism

- Acid-Base Interaction
  - Hydrogen bonding or Lewis acid base interaction
- Adsorption by Polarization of π electrons
  - Adsorption of electron rich aromatic nuclei onto strongly positive site

Hydrogen Bonding

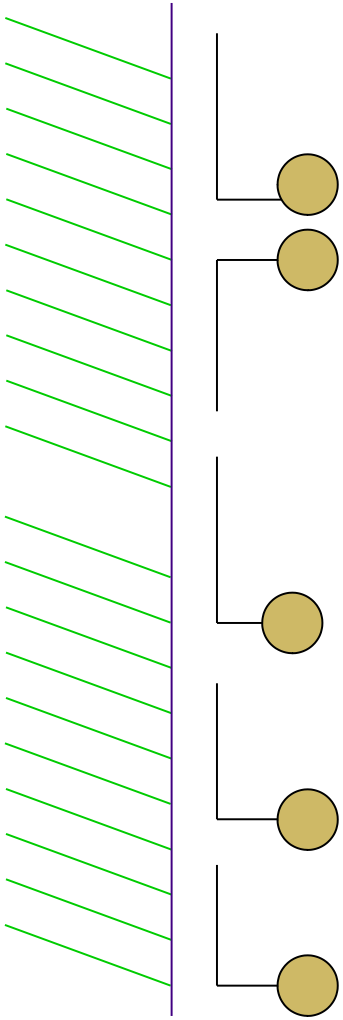


Adsorption Mechanism

- Adsorption by Dispersion Forces
  - Due to London-Van der Waals forces (induced dipole attraction form non-polar molecule)

- Hydrophobic bonding
  - Aggregation(□□) of hydrophobic groups for mutual(□□) attraction and their avoidance of the aqueous environment

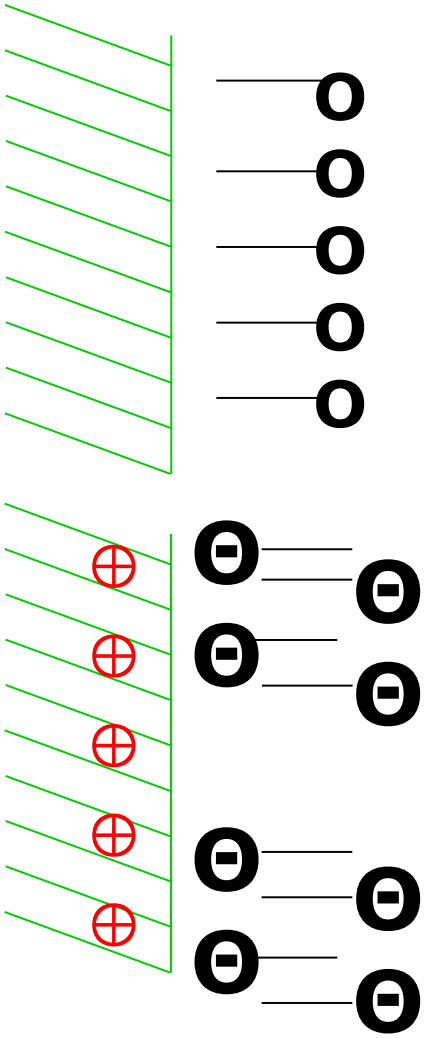
Dispersion forces on non-polar surface



Surface

Solution phase

Hydrophobic bonding



Surface

On uncharged surface

On charged surface

Adsorption at solid/liquid interface affected by:

Nature of solid surface

- Polar
- Non-polar

Structure of absorbate

- Ionic
- Nonionic

Environment of aqueous phase

- pH
- Temperature
- Additives

Adsorption depends on

- Surfactant
  - Type
  - Structure
    - Polar Group
    - Non-Polar Group
- Solvent
- Temperature
- Concentration of surfactant molecules

Points of interest

- Concentration of surfactant at interface → the performance of surfactant

- Orientation of surfactant at interface
  → how the interface will be affected

- Thermodynamic functions ΔG, ΔH, ΔS
  - Mechanism
  - Efficiency